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**Grade : IX**

**Subject : Biology**

**Chapter 7: Diversity in living world**

Biodiversity or biological diversity means the variety of living organisms present on a particular region. There are about 20 lac organisms known on the Earth which differ from one another in external form, internal structure, mode of nutrition, habitat, etc.

The warm and humid tropical regions of the Earth between the tropic of Cancer and the tropic of Capricorn have a rich diversity of life, i.e. plants, animals, and microorganisms and are called the region of mega biodiversity. India is one of the 12 countries which consist of more than half of the biodiversity of the Earth.

**Taxonomy** - It is a branch of biology which deals with identification, nomenclature, and classification of organisms. Carolus Linnaeus is called the father of taxonomy.

### Classification

The method of arranging organisms into groups or sets on the basis of similarities and differences is called classification.

**Importance of classification:**

- It makes the study of wide variety of organisms easy and in systematic manner.
- It helps to understand how the different organisms have evolved with time.
- It helps to understand the inter-relationships among different groups of organisms.
- It forms a base for the study of other biological sciences, like biogeography.

**Basis of classification:**

There are the certain features or properties used for the classification of living organisms which are known as characteristics. Organisms with same characteristics are placed in same groups.

**Classification system**

1. Two kingdom classifications: Carolus Linnaeus in 1758 classified the living organisms into two groups as plants and animals.

2. Five kingdom classification: H. Whittaker in 1959 further classified the organisms into five kingdoms as Kingdom Monera, Kingdom Protista, Kingdom Fungi, Kingdom Plantae, and kingdom Animalia.

**Note** - Carl Woese in 1977 further divided kingdom Monera into archaebacteria (or Archae) and Eubacteria (or Bacteria).

**Hierarchy of classification**

Linnaeus proposed a classification system by arranging organisms into taxonomic groups at different levels according to the characteristics they have. The groups or the levels from top to bottom are:

1. Kingdom
2. Phylum(Animals) / Division(Plants)
3. Class
4. Order
5. Family
6. Genus
7. Species

**Species:** A species is a group of living beings which can reproduce among themselves and keep their population alive.

# Hierarchical naming of Human

## The Five kingdom classification

The major characteristics considered for classifying all organisms into five major kingdoms are:

1. Type of cellular organization -

- a) Prokaryotic cells: These are primitive and incomplete cells without well – defined nucleus.
- b) Eukaryotic cells: These are advanced and complete cells with well – defined nucleus.

2. Body organization -

- a) Unicellular organisms: These are organisms made up of single cell with all activities performed by the single cell.
- b) Multicellular organisms: These are organisms made up of large number of cells with different functions performed by different cells.

3. Mode of obtaining food -

- a) Autotrophs: These are the organisms that make their own food by photosynthesis.
- b) Heterotrophs: These are the organisms which depend on other organisms for food.

Nomenclature - An organism can have different names in different languages. This creates confusion in naming organism. So, a scientific name is needed which is same in all languages. Binomial nomenclature system given by Carolus Linnaeus is used for naming different organisms.

Following are some conventions in writing the scientific names:

- Genus should be written followed by the species.
- First letter of the genus should be capital and that of the species should be in small letter.
- When printed the name should be written in italics and when written with hands genus and species should be underlined separately.

Example – *Homo sapiens* for humans, *Panthera tigris* for tiger.

### Kingdom 1: Monera

Following are its basic features:

- Prokaryotic, Unicellular.
- Can be autotrophic or heterotrophic.
- May or may not have cell wall.
- Examples- *Anabaena* and *Bacteria* (heterotrophic), *Cyano-bacteria* or *Blue green algae* (autotrophic).

### Kingdom 2 : Protista

Following are its basic features:

- Eukaryotic, Unicellular.
- Can be autotrophic or heterotrophic.
- May have cilia, flagella or pseudopodia for locomotion.
- Examples: plants like- Unicellular algae, Diatoms; animals like- protozoans (*Amoeba*, *Paramecium*, *Euglena*); fungi like- slime molds and water molds.

### Kingdom 3: Fungi

Following are its basic features:

- Eukaryotic
- Mostly multicellular but sometimes unicellular(yeast)
- Source of food:
  - a) Mostly saprophytes - these organisms use decaying material for food.
  - b) Some parasitic - these organisms live inside body of other living organism to have food and can be disease causing.
  - c) Symbiotic relation - these are relations between two organisms in which they live together for benefit of one or both. Lichens are a symbiotic relation between fungi and cyanobacteria. Here fungi gets food from cyanobacteria and in return cyanobacteria gets water and protection from sunlight through fungi.
- Cell wall is made of chitin
- Examples-mushrooms(Agaricus), green mold(Penicillium), smut(Aspergillus)

#### Kingdom 4: Plantae

Following are its basic features:

- Eukaryotic, Multicellular
- Autotrophs
- Cell wall present

#### Basis of division in Kingdom Plantae

1. Differentiated body parts: Body is differentiated into leaves, stems, roots, flower, etc.
2. Presence of vascular tissue: There are two types of vascular tissues present in the plants:
  - Xylem: helps in transport of water.
  - Phloem: helps in transport of food.
3. Reproduction through seeds or spores:
  - Phanerogamae: Plants with seeds are called phanerogamae. They contains embryo with stored food and are multicellular.
  - Cryptogamae: Plants with spores are called cryptogamae. They contains only naked embryo and are generally unicellular.
4. Seeds are inside the fruit or naked:
  - Angiospermae - these are plants with seeds inside the fruit and bears flowers.
  - Gymnospermae - these are plants with naked seeds and do not bear flowers.

Note - If xylem and phloem are absent the plants would be small as transport of food and water will be difficult.

#### Division 1: Thallophta

Following are its basic features:

- Basic and elementary plants with undifferentiated body parts.
- Generally called algae.
- No vascular tissue present.
- Reproduce through spores.
- Mainly found in water.
- Example- Ulva, Spirogyra, Ulothrix, Cladophora, Chara.

#### Division 2: Bryophyte

Following are its basic features:

- Body structure differentiated but not fully developed.
- No vascular tissues present.
- Reproduce through spores.
- Found on both land and water therefore known as ‘Amphibians of Plantae kingdom’.
- Example – liverwort (Marchantia, Riccia), mosses(Funaria), hornwort (dendrocerous).

### Division 3: Pteridophyta

Following are its basic features:

- Differentiated body structure- leaves, stems, roots,etc.
- Vascular tissues present.
- Reproduce through spores
- Examples- Marsilea, fern, horsetails

### Division 4: Gymnosperms

Following are its basic features:

- Differentiated body parts
- Vascular tissues
- Naked seeds without fruits or flowers
- Perennial, evergreen and woody
- Examples- Pines(deodar), Cycus, Ginkgo.

### Division 5: Angiosperms

Following are its basic features:

- Also known as Flower - bearing plants.
- Later on flower becomes fruit.
- Seeds are inside the fruit.
- Embryos in seeds have structure called They are also called seed leaves because in many plants they emerge and become green when they germinate.

Angiosperms are further divided on the basis of number of cotyledons into two parts:

### Kingdom 5: Animalia

Basis of classification of Animalia kingdom:

#### 1. Symmetry:

i) Bilateral symmetry: it is when an organism can be divided into right and left halves, identical but mirror images, by a single vertical plane.

ii) Radial symmetry: it is when an organism is equally spaced around a central point, like spokes on a bicycle wheel.

2. Germ layers : in embryonic stages there are different layers of cells called germ cells. The three different types of germ cells are -

- Ectoderm – It is the outermost layer which forms nail, hair, epidermis, etc.
- Endoderm - It is the innermost layer which forms stomach, colon, urinary bladder, etc.
- Mesoderm – It is the middle layer between ectoderm and endoderm which forms bones, cartilage, etc.

So, according to the number of germ layers present in embryonic stage, animal could be:

- i) Diploblastic - organisms which derived from two embryonic germ layers (ecto and endo).
  - ii) Triploblastic - organisms which derived from all the three embryonic germ layers.
3. Coelom: Body cavity or coelom is important for proper functioning of various organs. For example, heart which has to contract and expand needs some cavity or empty space, which is provided by the coelom.

On the basis of presence or absence of coelom, organisms are divided into:

- i) Acoelomates - these are the simple organisms having no body cavity.
  - ii) Coelomates - these are complex organisms having true cavity lined by mesoderm from all sides. These are further sub- divided into schizocoelomates or protostomes(coelom formed due to splitting of mesoderm) and enterocoelomates or dueterostomes( coelom formed from pouches pinched off from endoderm)
  - iii) Pseudo coelomate - these are organisms having false coelom. They have pouches of mesoderm scattered between endoderm and ectoderm.
4. Notochord: it is a long rod like structure, which runs along the body between nervous tissues and gut and provides place for muscle to attach for ease of movement.

Organisms could be:

- Without notochord
- With Notochord
- With Notochord in initial embryonic stages and vertebral column in adult phase.

Phylum 1: Porifera or sponges

Following are its basic features:

- Cellular level of organization.
- Non motile animals.
- Holes on body which led to a canal system for circulation of water and food.
- Hard outside layer called as skeletons.
- Examples - Sycon, Spongilla, Euplectelia.

Phylum 2: Coelenterata

Following are its basic features:

- Tissue level of organization
- No coelom
- Radial symmetry, Diploblastic
- Hollow gut
- Can move from one place to another.
- Examples: hydra, sea anemone, jelly fish( solitary) ; corals (colonies)

Phylum 3: Platyhelminthes

Following are its basic features:

- Also called flat worms.
- No coelom present
- Bilateral symmetry, Triploblastic
- Free living or parasite
- Digestive cavity has one opening for both ingestion and egestion.
- Example - Planaria (free living), Liver fluke (parasitic).

#### Phylum 4: Nematode

Following are its basic features:

- False coelom
- Bilateral symmetry, Triploblastic
- Cylindrical
- Many are parasitic worms living inside human body, and can cause various diseases, like Filarial worm causes elephantiasis, Round worms and Pin worms live in human intestine.
- Example - Ascaris, Wulchereria.

#### Phylum 5: Mollusca

Following are its basic features:

- Coelom present
- Triploblastic, bilateral symmetry
- Soft bodies sometimes covered with shell
- Generally not segmented
- No appendages present
- Muscular foot for movement
- Shell is present
- Kidney like organ for excretion
- Examples - Chiton, Octopus, Pila, Unio.

#### Phylum 6: Annelida

Following are its basic features:

- Second largest phylum
- Coelom present
- Bilateral, triploblastic
- Segmented ( segments specialized for different functions)
- Water or land
- Extensive Organ differentiation
- Examples - Earthworm, Leech, Nereis

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#### Phylum 7: Arthropoda

Following are the basic features:

- Largest phylum (consist of 80% of species)
- Generally known as insects.
- Coelom present
- Bilateral, triploblastic
- Segmented, sometimes fused
- Tough exo-skeleton of chitin
- Joint appendages like feet, antenna
- Example- Prawn, Scorpio, Cockroach, Housefly, Butterfly, Spider,

#### Phylum 8: Echinodermata

Following are its basic features:

- Spiny skin, Marine
- No notochord
- Coelom present , bilateral symmetry, triploblastic
- Endoskeleton of calcium carbonate.
- Water vascular system for locomotion.
- Bilateral symmetry before birth and radial symmetry after birth.
- Example- Antedon, Sea cucumber, Star fish, Echinus.

#### Phylum 9: Protochordata

Following are its basic features:

- Small group of marine animals
- Cylindrical, Bilateral symmetry, triploblastic
- Coelom present
- Gills for respiration
- Examples - Balanoglossus

#### Phylum 10: Chordata

Following are its basic features:

- Bilateral symmetry, Triploblastic
- Coelom present
- Notochord
- Gills present at some phase of life.
- Dorsal nerve chord
- Post anal tail present at some stage of life, For example, present in humans in embryonic stages.

(a) Vertebrata -

- Notochord converted to vertebral column
- 2,3,4 chambered heart
- Organs like kidney for excretion
- Pair appendages
- Example- humans(4 chambered), frog(3 chambered), fishes(2 chambered)

Vertebrates are divided into five classes namely Pisces, Amphibia, Reptillia, Aves and Mammalia.

Following are some common features of the five classes of vertebrates:

Note -

- Warm blooded organism: these are organisms which maintain same body temperature irrespective of outside temperature. Example – humans. Human’s body temperature is approximately 37°C.
- Cold blooded organisms: these are organisms which changes their body temperature as per surrounding temperature. Example – frog
- Fishes are divided into two on the basis of skeleton:
  - i) Fishes with bony skeleton called bony fishes. Example- Tuna.
  - ii) Fishes with cartilage skeleton called Cartilaginous fishes. Example – Shark

## Classification and evolution

Evolution is a process by which a new species is developed from an old species with gradual changes. Charles Darwin first described this idea of evolution in his book 'The Origin of species' in the year 1839.

More complex organisms develop from the simpler organisms. The older, simpler organisms are called primitive or lower organisms while the younger, complex organisms are called advanced or higher organisms.

Evolution and classification is somehow related, as classification of organism is done considering how evolution has occurred. While organisms classified in same group are likely to have evolved in similar ways.



## IMPORTANT QUESTIONS

- Find out incorrect sentence
  - (a) Protista includes unicellular eukaryotic organisms
  - (b) Whittaker considered cell structure, mode and source of nutrition for classifying the organisms in five kingdoms
  - (c) Both Monera and Protista may be autotrophic and heterotrophic
  - (d) Monerans have well defined nucleus
- Which among the following has specialised tissue for conduction of water?
  - Thallophyta
  - Bryophyta
  - Pteridophyta
  - Gymnosperms
  - (i) and (ii)
  - (ii) and (iii)
  - (iii) and (iv)
  - (i) and (iv)
- Which among the following produce seeds?
  - Thallophyta
  - Bryophyta
  - Pteridophyta
  - Gymnosperms
- Which one is a true fish?
  - Jellyfish
  - Starfish
  - Dogfish
  - Silverfish
- Which among the following is exclusively marine?
  - Porifera
  - Echinodermata
  - Mollusca
  - Pisces
- Which among the following have open circulatory system?
  - Arthropoda
  - Mollusca
  - Annelida
  - Coelenterata
  - (i) and (ii)
  - (iii) and (iv)
  - (i) and (iii)
  - (ii) and (iv)
- In which group of animals, coelom is filled with blood?

- (a) Arthropoda
  - (b) Annelida
  - (c) Nematoda
  - (d) Echinodermata
8. Elephantiasis is caused by
- (a) Wuchereria
  - (b) Pinworm
  - (c) Planarians
  - (d) Liver flukes
9. Which one is the most striking or (common) character of the vertebrates?
- (a) Presence of notochord
  - (b) Presence of triploblastic condition
  - (c) Presence of gill pouches
  - (d) Presence of coelom
10. Which among the following have scales?
- (i) Amphibians
  - (ii) Pisces
  - (iii) Reptiles
  - (iv) Mammals
- (a) (i) and (iii)
  - (b) (iii) and (iv)
  - (c) (ii) and (iii)
  - (d) (i) and (ii)
11. Find out the false statement
- (a) Aves are warm blooded, egg laying and have four chambered heart
  - (b) Aves have feather covered body, fore limbs are modified as wing and breathe through lungs
  - (c) Most of the mammals are viviparous
  - (d) Fishes, amphibians and reptiles are oviparous
12. Pteridophyta do not have
- (a) root
  - (b) stem
  - (c) flowers
  - (d) leaves
13. Identify a member of porifera
- (a) Spongilla
  - (b) Euglena
  - (c) Penicillium
  - (d) Hydra
14. Which is not an aquatic animal?
- (a) Hydra
  - (b) Jelly fish

- (c) Corals
  - (d) Filaria
15. Amphibians do not have the following
- (a) Three chambered heart
  - (b) Gills or lungs
  - (c) Scales
  - (d) Mucus glands
16. Organisms without nucleus and cell organelles belong to
- (i) fungi
  - (ii) protista
  - (iii) cyano bacteria
  - (iv) archae bacteria
- (a) (i) and (ii)
  - (b) (iii) and (iv)
  - (c) (i) and (iv)
  - (d) (ii) and (iii)
17. Which of the following is not a criterion for classification of living organisms?
- (a) Body design of the organism
  - (b) Ability to produce one's own food
  - (c) Membrane bound nucleus and cell organelles
  - (d) Height of the plant
18. The feature that is not a characteristic of protochordata?
- (a) Presence of notochord
  - (b) Bilateral symmetry and coelom
  - (c) Jointed legs
  - (d) Presence of circulatory system
19. The locomotory organs of Echinoderms are
- (a) tube feet
  - (b) muscular feet
  - (c) jointed legs
  - (d) parapodia
20. Corals are
- (a) Poriferans attached to some solid support
  - (b) Cnidarians, that are solitary living
  - (c) Poriferans present at the sea bed
  - (d) Cnidarians that live in colonies
21. Who introduced the system of scientific nomenclature of organisms
- (a) Robert Whittaker
  - (b) Carolus Linnaeus
  - (c) Robert Hooke
  - (d) Ernst Haeckel

22. Two chambered heart occurs in
- (a) crocodiles
  - (b) fish
  - (c) aves
  - (d) amphibians
23. Skeleton is made entirely of cartilage in
- (a) Sharks
  - (b) Tuna
  - (c) Rohu
  - (d) None of these
24. One of the following is not an Annelid
- (a) Nereis
  - (b) Earthworm
  - (c) Leech
  - (d) Urchins
25. The book Systema Naturae was written by
- (a) Linnaeus
  - (b) Haeckel
  - (c) Whittaker
  - (d) Robert Brown
26. Karl Von Linne was involved with which branch of science?
- (a) Morphology
  - (b) Taxonomy
  - (c) Physiology
  - (d) Medicine
27. Real organs are absent in
- (a) Mollusca
  - (b) Coelenterata
  - (c) Arthropoda
  - (d) Echinodermata
28. Hard calcium carbonate structures are used as skeleton by
- (a) Echinodermata
  - (b) Protochordata
  - (c) Arthropoda
  - (d) Nematoda
29. Differentiation in segmental fashion occurs in
- (a) Leech
  - (b) Starfish
  - (c) Snails
  - (d) Ascaris

30. In taxonomic hierarchy family comes between

- (a) Class and Order
- (b) Order and Genus
- (c) Genus and Species
- (d) Division and Class

31. 5-Kingdom classification has given by

- (a) Morgan
- (b) R. Whittaker
- (c) Linnaeus
- (d) Haeckel

32. Well defined nucleus is absent in

- (a) blue green algae
- (b) diatoms
- (c) algae
- (d) yeast

33. The 'Origin of Species' is written by

- (a) Linnaeus
- (b) Darwin
- (c) Hackel
- (d) Whittaker

34. Meena and Hari observed an animal in their garden. Hari called it an insect while Meena said it was an earthworm. Choose the character from the following which confirms that it is an insect.

- (a) Bilateral symmetrical body
- (b) Body with jointed legs
- (c) Cylindrical body
- (d) Body with little segmentation

### Short Answer Type Questions

35. Write true (T) or false (F)

- (a) Whittaker proposed five kingdom classification.
- (b) Monera is divided into Archaeobacteria and Eubacteria.
- (c) Starting from Class, Species comes before the Genus.
- (d) Anabaena belongs to the kingdom Monera.
- (e) Blue green algae belongs to the kingdom Protista.
- (f) All prokaryotes are classified under Monera.

36. Fill in the blanks

- (a) Fungi shows \_\_\_\_ mode of nutrition.
- (b) Cell wall of fungi is made up of \_\_\_\_ .
- (c) Association between blue green algae and fungi is called as \_\_\_\_ .
- (d) Chemical nature of chitin is \_\_\_\_ .
- (e) \_\_\_\_ has smallest number of organisms with maximum number of similar characters

(f) Plants without well differentiated stem, root and leaf are kept in \_\_\_\_ .

(g) \_\_\_\_ are called as amphibians of the plant kingdom.

37. You are provided with the seeds of gram, wheat, rice, pumpkin, maize and pea. Classify them whether they are monocot or dicot.

38. Match items of column (A) with items of column (B)

(A)	(B)
(a) Naked seed	(A) Angiosperms
(b) Covered seed	(B) Gymnosperms
(c) Flagella	(C) Bryophytes
(d) <i>Marchantia</i>	(D) <i>Euglena</i>
(e) <i>Marsilea</i>	(E) Thallophyta
(f) <i>Cladophora</i>	(F) Pteridophyta
(g) <i>Penttilium</i>	(G) Fungi

39. Match items of column (A) with items of column (B)

(A)	(B)
(a) Pore bearing animals	(A) Arthropoda
(b) Diploblastic	(B) Coelenterata
(c) Metameric segmentation	(C) Porifera
(d) Jointed legs	(D) Echinodermata
(e) Soft bodied animals	(E) Mollusca
(f) Spiny skinned animals	(F) Annelida

40. Classify the following organisms based on the absence/presence of true coelom (i.e., acoelomate, pseudocoelomate and coelomate)

<b><i>Spongilla</i>,</b>	<b>Sea anemone,</b>	<b>Planaria,</b>	<b>Liver fluke</b>
<b><i>Wuchereria</i>,</b>	<b><i>Ascaris</i>,</b>	<b><i>Nereis</i>,</b>	<b>Earthworm,</b>
<b>Scorpion,</b>	<b>Birds,</b>	<b>Fishes,</b>	<b>Horse.</b>

41. Endoskeleton of fishes are made up of cartilage and bone; classify the following fishes as cartilaginous or bony

Torpedo,	Sting ray,	Dog fish,
Rohu,	Angler fish,	Exocoetus.

42. Classify the following based on number of chambers in their heart.

Rohu, Scoliodon, Frog, Salamander, Flying lizard, King Cobra, Crocodile, Ostrich, Pigeon, Bat, Whale

43. Classify Rohu, Scoliodon, Flying lizard, King Cobra, Frog, Salamander,

Ostrich, Pigeon, Bat, Crocodile and Whale into the cold blooded/warm blooded animals.

44. Name two egg laying mammals.

45. Fill in the blanks

(a) Five kingdom classification of living organisms is given by \_\_\_\_ .

(b) Basic smallest unit of classification is \_\_\_\_ .

(c) Prokaryotes are grouped in Kingdom \_\_\_\_ .

(d) Paramecium is a protist because of its \_\_\_\_ .

(e) Fungi do not contain \_\_\_\_ .

(f) A fungus \_\_\_\_ can be seen without microscope.

(g) Common fungi used in preparing the bread is \_\_\_\_ .

(h) Algae and fungi form symbiotic association called \_\_\_\_ .

46. Give True (T) and False (F)

- (a) Gymnosperms differ from Angiosperms in having covered seed.
- (b) Non flowering plants are called Cryptogamae.
- (c) Bryophytes have conducting tissue.
- (d) Funaria is a moss.
- (e) Compound leaves are found in many ferns.
- (f) Seeds contain embryo.

47. Give examples for the following

- (a) Bilateral, dorsiventral symmetry is found in \_\_\_\_ .
- (b) Worms causing disease elephantiasis is \_\_\_\_ .
- (c) Open circulatory system is found in \_\_\_\_ where coelomic cavity is filled with blood.
- (d) \_\_\_\_ are known to have pseudocoelom.

48. Label a,b,c and d. given in Fig. 7.1 Give the function of (b)

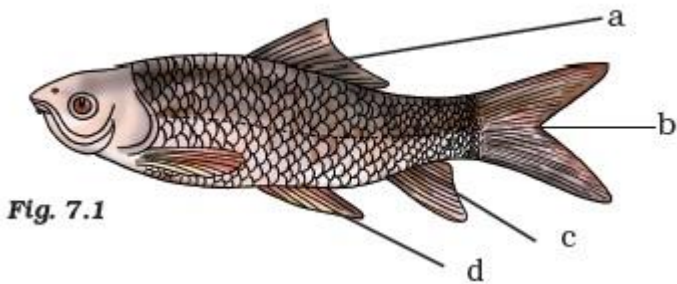


Fig. 7.1

49. Fill in the boxes given in Fig. 7.2 with appropriate characteristics/plant group (s)

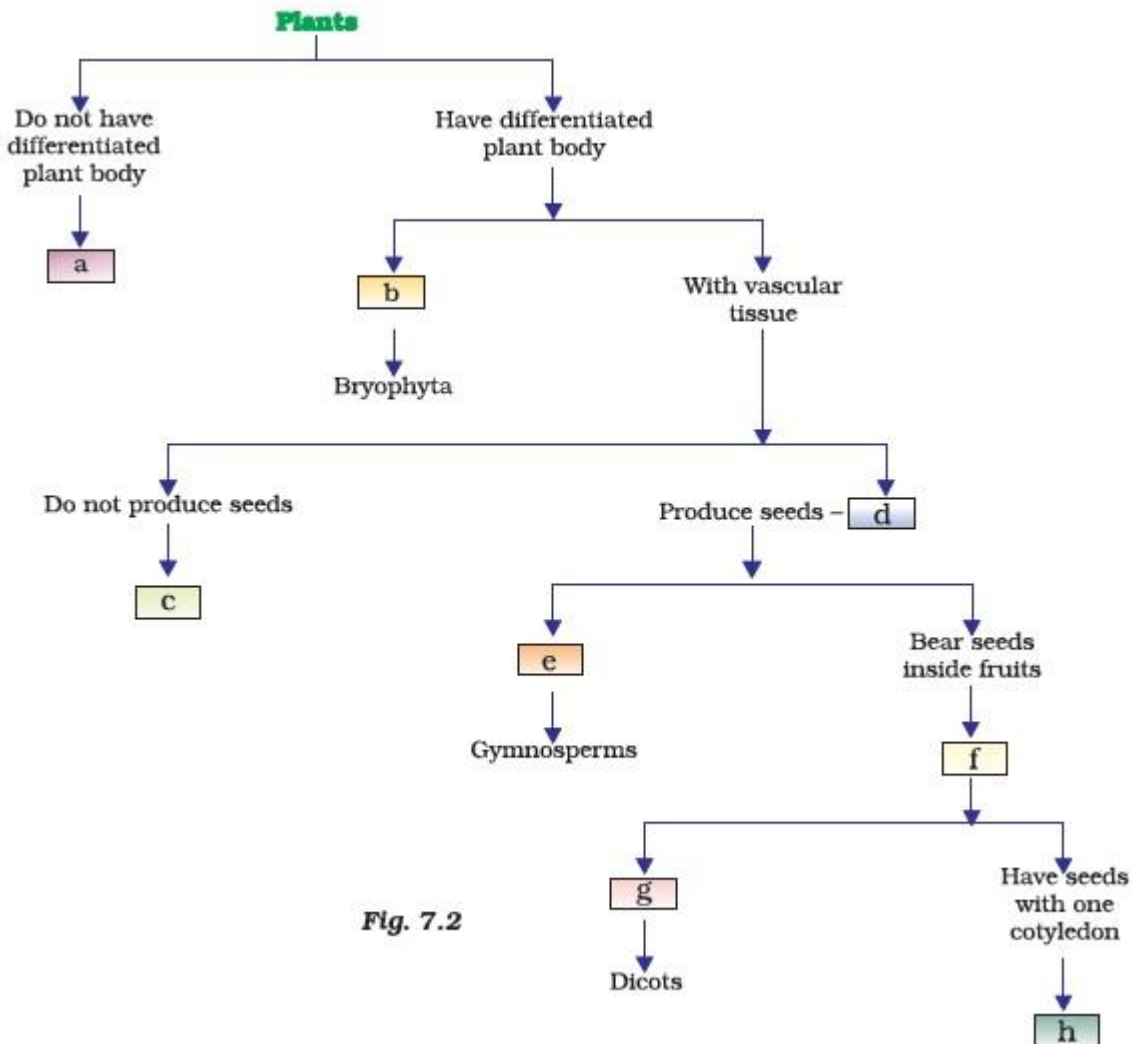


Fig. 7.2

### Long Answer Type Questions

50. Write names of few thallophytes. Draw a labelled diagram of Spirogyra.
51. Thallophyta, bryophyta and pteridophyta are called as 'Cryptogams'. Gymnosperms and Angiosperms are called as 'phanerogams'. Discuss why? Draw one example of Gymnosperm.
52. Define the terms and give one example of each
- (a) Bilateral symmetry
  - (b) Coelom
  - (c) Triploblastic
53. You are given leech, Nereis, Scolopendra, prawn and scorpion; and all have segmented body organisation. Will you classify them in one group? If no, give the important characters based on which you will separate these organisms into different groups.
54. Which organism is more complex and evolved among Bacteria, Mushroom and Mango tree. Give reasons.
55. Differentiate between flying lizard and bird. Draw the diagram.
56. List out some common features in cat, rat and bat.
57. Why do we keep both snake and turtle in the same class?

### Answers to Multiple Choice Questions

1. (d) 2. (c) 3. (d) 4. (c) 5. (b)
6. (a) 7. (a) 8. (a) 9. (a) 10. (c)
11. (d) 12. (c) 13. (a) 14. (d) 15. (c)
16. (b) 17. (d) 18. (c) 19. (a) 20. (d)
21. (b) 22. (b) 23. (a) 24. (d) 25. (a)
26. (b) 27. (b) 28. (a) 29. (a) 30. (b)
31. (b) 32. (a) 33. (b) 34. (b)